CEMENT MILL SECTION of

Concrete

The Cement Mill Edition of Concrete is edited exclusively for those interested in the manufacture of portland cement. Its pages are devoted to discussions of plant design, management, operation, production efficiency, chemical research and control, quarry operation, progress and news of the industry.

The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

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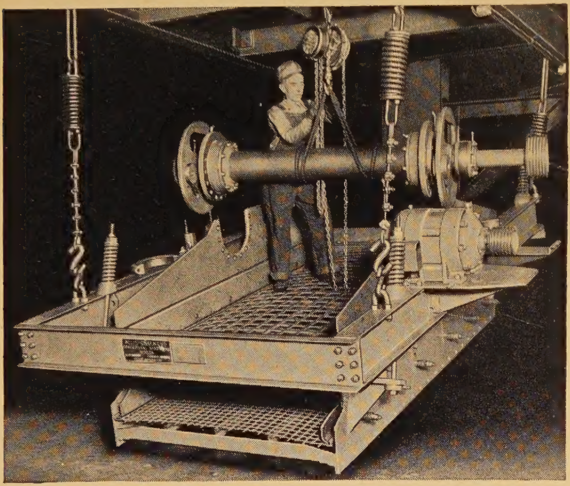
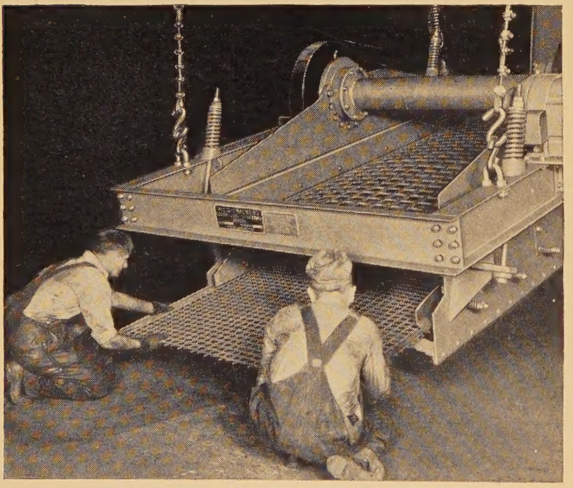
With New Style B Vibrating Screens



Driving Mechanism is convenient for inspection and is easily removed or replaced



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Allis-Chalmers Manufacturing Company, Milwaukee

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Utilization of Heat from Clinker for Preheating Secondary Air

Direct Saving in Kiln Fuel Is 15 to 17 Per Cent—Cost of Installation Returned in Two Years—Other Sources of Economy

By RAPIER R. COGHLAN
Consulting Engineer, La Salle, Illinois

> **The information contained in this article is based on the author's own experience with the operation and adjustment of several important and successful heat-recuperative installations in cement plants.**
>
> **It should be emphasized that the saving in fuel is not the only source of economy. More rapid cooling of the clinker is the direct cause of improved grindability, an increase in the quantity of sub-sieve fines, and higher strength values in the finished product. Still further savings result from the fact that less coal needs to be handled in the yard, dried and pulverized, and from the lower power requirements for grinding the clinker.**
>
> **Because of these combined savings, a properly designed heat-recuperative installation may be written off the books in a very few years.—The Author.**

THE utilization of heat from clinker for the preheating of secondary air for the combustion of fuel in rotary cement kilns is a subject that has always claimed the attention of the cement industry, but only within the last three or four years has it seemed possible of successful remunerative accomplishment.

Air for the combustion of fuels used in operating rotary kilns is divided into primary and secondary. Primary air is blown in with the fuel and in the case of pulverized coal acts as a conveying medium for transporting the coal into the combustion chamber and giving an intimate mixture of air and coal before ignition ensues.

Primary air is generally low-pressure air at atmospheric temperature, or it may be heated to an extent that does not cause pre-ignition of the coal in the burner pipe or cause an abnormal behavior of the flame. In the case of pulverized coal the primary air may amount to 20 to 35 per cent of the total air required for complete combustion of the coal. The amount is always under the control of the kiln operator and remains quite constant under any given set of operating conditions.

Secondary air, whether supplied by natural or induced draft, enters the kiln through the clinker chute, around the hood and through openings in the hood. Its amount varies from time to time as the speed of the kiln is altered, as the amount of kiln feed varies, and as dust doors are opened in the rear housing. At best it is under the loose control of the kiln operator. Naturally the points at which the secondary air enters the kiln result in some preheating, but it is irregular and uncontrolled.

Specific Heat

A well operated kiln discharges clinker at a temperature around 2100 deg. F. The specific heat of clinker of normal composition may be expressed by the formula—

Clinker—$0.19 + 0.000044\,t$, where t is in deg. F.

The quantity of heat in the clinker at t deg. F. is expressed by the equation—

$$Qt = (0.19t + 0.000022t^2) \times 376$$

Q is expressed in B.t.u. per barrel.

Apparatus designed to cool the clinker to 150 deg. F. would recover—

$$Q = [0.19\,(2100 - 150) + 0.000022\,(2100^2 - 150^2)] \times 376, \text{ or } 175{,}977 \text{ B.t.u.}$$

This is equivalent to 14.67 lb. of 12,000-B.t.u. coal. It is at once obvious that here is a large potential reservoir for the preheating of secondary air. In the discussion that follows it will be shown that, without utilizing all of this heat, more fuel saving is possible than that just indicated.

In his "Metallurgical Calculations," J. W. Richards gives the following values for the mean specific heat of oxygen and nitrogen:

Oxygen, S_m $(0 - t°)$, $(0.2104 + 0.0000104t)$ up to 3600 deg. F.

Nitrogen, S_m $(0 - t°)$, $(0.2405 + 0.0000119t)$ up to 3600 deg. F.

Converting the above values into molal values it is found that--

Nitrogen, oxygen $M_{mcp} = 6.58 + 0.000333\,T$.

$(T - 460)$ is substituted for t.

This value is somewhat larger than that given by Walker, Lewis and McAdams in "Principles of Chemical Engineering." The latter value is for oxygen, nitrogen and air—

$$M_{mcp} = 6.5 + 0.000275\,T$$

and the quantity of heat between any two temperatures T and T_1 is—

$$Q_{T-T_1} = 6.5(T - T_1) + 0.000275(T^2 - T_1{}^2)$$

Analysis of Coal

The development of this discourse is through the use of actual coal analyses and a consideration of what can be accomplished by the use of preheated air in connection with these types of cement coal. Here follows a typical analysis of a medium grade of coal. Its ultimate composition is converted into mols on the basis of 100 lb. of coal. The air required for complete combustion is calculated as well as the products of combustion.

	Per Cent		M.W.	Mols
Carbon	64.60	÷	12	5.39
Hydrogen	5.00	÷	2	2.50
Oxygen	12.33	÷	32	.39
Nitrogen	1.61	÷	28	.06
Sulphur	2.62	÷	32	.08
B.t.u. as fired	11,521			

The oxygen required is $C(5.39) + H(2.50/2) + S(0.08) - O(0.39) = 6.33$ mols. Air required is 6.33/0.21, or 30.14 mols. The nitrogen with this air is 23.81 mols. The products of combustion of 100 lb. of the coal are—

Carbon dioxide	5.39 mols
Water vapor	2.50 mols
Sulphur dioxide	.08 mols
Nitrogen	23.87 mols
Total	31.84 mols

It is assumed that before recuperation was practiced 120 lb. of this coal was required to produce a barrel of clinker. Therefore 1.2 × 30.14 = 36.17 mols of air are required per barrel of clinker. If the air were divided 30 per cent primary and 70 per cent secondary, there would be required 0.7 × 36.17 = 25.32 mols of secondary air per barrel. It is desired to heat all of this secondary air as high as possible by intimate contact with the clinker discharged from the kiln into a suitable mechanism. Atmospheric air is at 80 deg. F., the discharged clinker is at 2,100 deg. F., and the desired temperature is t deg. F.

T in the molal formula is replaced by $(t + 460)$.

Then $376[0.19(2{,}100 - t) + 0.000022(2{,}100^2 - t^2)]$
$= 25.32[6.5(t - 80) + 0.000275(\overline{t + 460}^2 - 540^2)]$

The expanded equation is—

$$0.015235t^2 - 242.42t + 200{,}226.96 = 0$$

Whence $t = 787$ deg. F.

The heat returned to the kiln in 25.32 mols of air preheated to 787 deg. F. is 125,157 B.t.u. This is equivalent to 10.86 lb. of the coal under consideration. Apparently only 120 — 10.86 = 109.14 lb. of coal will now be required to produce a barrel of clinker. The air for the complete combustion of 109.14 lb. of coal is 1.0914 × 30.14, or 32.89 mols. Cutting the primary air so that all of the heat in the secondary air may be available, it is found under the new condition that the primary air has decreased from 30 per cent to 23 per cent.

Preheating of primary air can be carried to 250 deg. F. in some cases, but as a rule pre-ignition of coal in the fuel pipe follows such temperature. The type of coal governs this temperature. For most coals 150 deg. F. is a safe temperature for primary air.

One pound of the coal under discussion requires 0.3014 mols of air for complete combustion. What will be the effect of preheating on the calorific value of the fuel?

Case 1—Atmospheric Air at 80 *Deg. F., Primary Air at* 150 *Deg. F.*

$0.30 \times 0.3014 = 0.09042$ mols primary air per lb. of coal

$0.09042\,[6.5(610 - 540) + 0.000275(610^2 - 540^2)] = 43$ B.t.u.

The coal has a heating value of 11,521 B.t.u. Imperfect mixing of air and coal, delayed combustion, etc., decrease this value by 10 per cent so far as attaining the theoretical calorific intensity is concerned. Therefore the calorific value of the fuel and primary air is 0.9 × 11,521 + 43 = 10,412 B.t.u.

Case 2—Primary Air at 150 *Deg. F. and Equal to* 23 *Per Cent, Secondary Air at* 787 *Deg. F. and* 77 *Per Cent*

0.77×0.3014 .... $0.23208[6.5(1247 - 540) + 0.000275(1247^2 - 540^2)] = 1{,}147$ B.t.u.

0.23×0.3014 .... $0.06932[6.5(610 - 540) + 0.000275(610^2 - 540^2)] = 33$ B.t.u.

Total 1,180 B.t.u.

The calorific power of the fuel is now 0.9 × 11,521 + 1,180 = 11,549 B.t.u.

The products of combustion of the fuel cool to approximately 1,400 deg. F. before leaving the kiln. Therefore the unavailable heat per pound of fuel will be the same in both cases, namely, 4,795 B.t.u. per pound of fuel burned. The origin of this value will be shown later in the discussion of theoretical flame temperatures. The available heat per pound of fuel burned is—

11,549 — 4,795 = 6,754 B.t.u. with air preheated to 787 deg. F., and

10,412 — 4,795 = 5,617 B.t.u. with air at 80 deg. F.

109.14 × 6,754 = 737,132 B.t.u. available with air at 787 deg. F., and

120 × 5,617 = 674,040 B.t.u. available with air at 80 deg. F.

Since 674,040 B.t.u. was actually producing a barrel of clinker in the first case, then $\dfrac{674{,}040 \times 109.14}{737{,}132} = 99.80$ lb. of fuel required when the air is preheated to 787 deg. F.

Proof:

Using air preheated to 787 deg. F.—

99.8 × 11,549 = 1,152,590 B.t.u. calorific input of kiln.
99.8 × 4,795 = 478,541 B.t.u. lost in exit gases of kiln at 1,400 deg. F.

674,049 B.t.u. available in the kiln.

Using air at 80 deg. F.—

120.0 × 10,412 = 1,249,440 B.t.u. calorific input of kiln.
120.0 × 4,795 = 575,400 B.t.u. lost in exit gases at 1,400 deg. F.

674,040 B.t.u. available in kiln.

The possible fuel saving, using secondary air at 787 deg. F., is 20.2 lb. per barrel, or 16.83 per cent.

Raising Theoretical Flame Temperature

At this point it is well to examine the effect of the preheated air on the theoretical flame temperature. This is done by the usual method.

CO_2, SO_2 ...... $0.0547[7.0\ T + .00195\ T^2 - 0.000000228\ T^3]$
H_2O ...... $0.0250[8.81\ T - .000525\ T^2 + 0.000000195\ T^3]$
N_2 ...... $0.2387[6.5\ T + .000275\ T^2]$

$$2.1547\ T + 0.0001591825\ T^2 - 0.0000000075966\ T^3 = 9{,}678$$

Whence $T = 3{,}670$ deg. absolute, or $t = 3{,}210$ deg. F.
And again

$$2.1547\ T + 0.0001591825\ T^2 - 0.0000000075966\ T^3 = 10{,}129$$

Whence $T = 3{,}835$ deg. absolute, or $t = 3{,}375$ deg. F.

Preheating of the air has raised the theoretical flame temperature 165 deg. F. It is a well founded fact that most chemical reactions have their rate of reaction practically doubled for each rise of 18 deg. F. According to Haslam and Russell, "Fuels and Their Combustion," at very high temperatures such as exist in flames, the rate is doubled for each 180 deg. F. rise. As a result we would expect more rapid generation of heat from the fuel using preheated air than is possible with air at ordinary temperature. Gas analyses from kilns using heat recuperators generally show more complete combustion than is found in kilns operating in the usual manner. Poor initial mixing of primary air and fuel is responsible for a larger loss of calorific intensity than is generally supposed. Preheated air decreases this loss, although in the examples cited the loss is assumed the same for both cases.

Percentage of Reduction in Fuel

So little is known of the radiation from flames that it is idle to speculate on the relative heat transfer from flames of different temperatures. However, we do know that the intensity of radiation varies as the fourth power of the absolute temperature, taking into account suitable constants. Therefore we would be justified in thinking that a greater amount of heat would be transferred by radiation from the hotter flame. The relative velocity of the gases of combustion is decreased when using preheated air. The flame is shorter and more intense than when using atmospheric air and the practical working out of preheated air is the speeding up of the kiln, resulting in increased production and a further reduction in fuel per barrel.

We saw above that only 99.8 lb. of coal were required when using air preheated to 787 deg. F. The air required for 99.8 lb. of coal is 99.8 × 0.3014 = 30.08 mols. On the assumption that 30 per cent primary air gives the best results, there are required 9.02 mols of primary air and 21.06 mols of secondary air. The temperature to which this secondary air can be raised is 872 deg. F. Therefore we obtain a new calorific value for each pound of fuel.

	B.t.u.
Primary air, $0.0904[6.5(610 - 540) + 0.000275(610^2 - 540^2)] =$	43
Secondary air, $0.2110[6.5(1{,}332 - 540) + 0.000275(1{,}332^2 - 540^2)] =$	1,171
	1,214
Ordinary heating value of the coal	10,369
New heating value of the coal	11,583
Heat lost in products of combustion at 1,400 deg. F.	4,795
Heat available in kiln per lb. of coal	6,788

Then

$$\frac{5{,}617 \text{ B.t.u. (heat available per lb. of coal—air normal)}}{6{,}788 \text{ B.t.u. (heat available per lb. of coal—air at } 872^\circ \text{ F.)}} \times 120 = 99.29.$$

Thus increasing the preheating from 787 to 872 deg. has increased the fuel saving from 16.83 per cent to 17.25 per cent.

The reader may well ask the question—"Is preheating of all of the air as advantageous as heating a portion of it to a higher temperature?"

The answer to this question depends upon the operation of the kiln. Obviously if all of the secondary air is preheated, the primary air must be cut to fit the conditions, in order to avoid excess air with its attendant chilling effect on the flame and unavoidable heat loss in the exit gases of the kiln. The gain in efficiency is so slight for the 85 degrees increase above that it will pay to investigate what another 85 degrees will do. The air will be preheated to 957 deg. F. The clinker will give up 110,559 B.t.u., equivalent to 9.59 lb. of the coal under consideration. This reduces the apparent fuel consumption to 110.41 lb. per barrel and calls for 33.28 mols of air for its complete combustion, of which 17.84 mols were preheated by the clinker to 957 deg. F. This is 0.533 of the total air required, keeping primary air at 0.30. The new heating value of the coal under this condition is 11,409 B.t.u., or 6,614 B.t.u. available.

$$\text{Then } \frac{110.41 \times 674{,}040}{110.41 \times 6{,}614} = 101.91 \text{ lb. of coal required.}$$

The fuel saving has now dropped to 15.07 per cent. Obviously the optimum point has been passed somewhere between 787 and 957 deg. F.

We have dealt with a medium grade of coal such as is used in many plants with good results. What would be the effect of a better grade of coal? Would the economy be as great? It is well to reflect on the fact that during the past two years the cement producer has been able to get coal at practically his own price, at times a ridiculously low price. These conditions cannot be expected to prevail, and it is not a far-fetched idea to assume that the time is coming when coal will be purchased on a heat unit basis. This will be fairer for both parties.

Saving in Fuel Regardless of Grade

For comparison with the first coal a West Virginia coal is taken. Its heating value is 12,991 B.t.u. The air required is 33.37 mols per 100 lb. and the products of combustion of 1 lb. of coal are—

CO_2	0.0595 mols
SO_2	0.0003 mols
H_2O	0.0260 mols
N_2	0.2641 mols
Total	0.3499 mols

A barrel of clinker is produced under normal air conditions with 107 lb. of this coal. It is found that 26.2 mols of air, the secondary air required, can be heated to 771 deg. F. The heat recovered by this air is 126,494 B.t.u., equivalent to 9.73 lb. of the coal, reducing the apparent coal requirement to 97.27 lb. If all of this air is used the secondary air is reduced to 19.3 per cent, near the usual lower limit. At 1,400 deg. F., the products of combustion of 1 lb. of coal withdraw 4,949 B.t.u. from the kiln. With the 10 per cent heat loss used before, under normal air conditions 1 lb. of coal has a heating value of 11,739 B.t.u. and at 771 deg. F. a value of 12,992 B.t.u. Therefore the heat available in the kiln is 12,992 — 4,949 = 8,043 B.t.u. with the preheated air, and 11,739 — 4,949 = 6,790 B.t.u. with normal operation.

97.27 × 8,043 = 782,343 B.t.u. available with air at 771 deg. F.

107.00 × 6,790 = 726,530 B.t.u. available with normal air.

Then to produce the same heat effect in the kiln—

$$\frac{97.27 \times 726{,}530}{782{,}343} = 90.33 \text{ lb. of coal.}$$

This is a saving of 15.58 per cent.

Proof:

90.33 × 12,992 = 1,173,567 B.t.u. kiln input with air at 771 deg. F.

90.33 × 4,949 = 447,043 B.t.u. lost at 1,400 deg. F.

726,524 B.t.u. available in kiln.

107.00 × 11,739 = 1,256,073 B.t.u. kiln input with normal operation.

107.00 × 4,949 = 529,543 B.t.u. lost at 1,400 deg. F.

726,530 B.t.u. available in kiln.

Thus it is seen that the type of coal has little effect on the possible saving from preheating air. Naturally the more air required per pound of coal, the greater will be the heat lost in the exit gases. Also variations in the moisture content of the dried coal affect both flame and exit gas. The higher the delivered cost of the coal, the greater is the possible saving by preheating of air. As delivered, the two coals considered have 10,599 B.t.u. and 12,817 B.t.u., respectively. On a heat unit basis, if the first coal cost $3.00 per ton delivered, the second coal would cost $3.63 per ton. The cost of 1 lb. of the coals is $0.0015 and $0.001815, respectively.

Then 130.04 × $0.0015 = $0.1956 per barrel of clinker.
and 0.15 × $0.1956 = $0.02934 per barrel saved by preheating.

Also 108.4 × $0.001815 = $0.19675 per barrel of clinker.
0.15 × $0.19675 = $0.02951 per barrel saved by preheating.

On the basis of 350 days operation and an output of 1,440 barrels per day per kiln, the annual saving by preheating the air would amount to $14,873.04 per kiln.

In addition to the fuel saved, there is 15 per cent less handling of coal in the yards, less drying and pulverizing, and an additional credit of at least 20 per cent less power in the finish grinding of the clinker. Where power is purchased this is a considerable item.

Considering all sources of economy resulting from the utilization of heat from the clinker for preheating the secondary air for the combustion of kiln fuel, and balancing this saving against the cost of the installation of the heat-recuperative mechanism, the writer's experience with several important installations of this character leads to the conclusion that the cost of an installation can be written off in about two years. Following that period, the reduction in operating cost is a very substantial figure.

Additional Sources of Economy

It is not to be assumed that the calculated figures here given represent all of the saving possible. As intimated, no credit has been given the increased transfer of heat from the hotter flame, using preheated air, to the lining and clinker. While there is no satisfactory way of calculating this, we know that it is large, for actual recuperative systems show greater fuel economy than can be accounted for in the heat returned with the air. The installation of any new mechanism around the firing end of the kiln is bound to result in better fuel economy. The placing of all air supply under the burner's control puts him on his toes. Insulation of the cooler portion of the kiln shell also increases the possible saving where fuel economy is a prime factor.

Six Hundred Given Work at Universal Plant

More than 600 men are being given part-time employment as a result of the reopening of Plant No. 4 of Universal Atlas at Northampton, Pa., on April 3.

The resumption is for the purpose of replenishing stock and the length of time the plant will work depends upon conditions that may arise, M. W. Winsch, plant manager, stated in announcing the reopening.

Wolverine Plant Reopens

One hundred men were recalled by the Wolverine Portland Cement Co. at Coldwater, Mich., on April 11, after a lay-off of several months. The men will work three eight-hour shifts daily.

The Quincy, Mich., plant likewise reopened a few days later.

Cement Association Reopens Minnesota Office

The Portland Cement Association has reopened its office at Minneapolis, under the direction of F. S. Altman, district engineer. Mr. Altman has been in charge of association activities in Minnesota for several years.

Lone Star Plant Uses Gas as Fuel

The use of gas as fuel was initiated early in April at the Lone Star plant at Bonner Springs, Kans.

Recovered Coal Ash Made Available as Raw Material

Chemical Composition of Ash—Chemical Treatment Recovers Magnetic Iron Oxide and Excess Alumina as By-Products

THE possibility of recovering and utilizing coal ashes from the kiln gases of a cement mill, as well as from the flue dust of the power plant if pulverized coal is used as fuel, is seen in a process for which an American patent has recently been granted.

The process results in the recovery of several useful by-products not required in cement manufacture; but its primary purpose is the recovery of the silica in the coal ashes in the form of a siliceous hydrate, to be used as a raw material in cement manufacture.

Other by-products include a magnetic iron oxide, largely Fe_3O_4, which may be separated from the ash by means of a magnetic separator. Following this, the ash may be treated with mineral acids such as HCL, HNO_3, H_2SO_4 or $HClO_4$, or combinations of these, to dissolve the base minerals such as alumina, any iron oxide that may remain after the magnetic separation, as well as the minor oxides present, if considered necessary.

Chemical and Physical Transformations

The ash content of bituminous coal may vary from 5 to 15 per cent of the weight of the coal. The temperature of the flame produced in burning pulverized coal may approach closely to 2,000 deg. C. The temperature of the flue gases falls rapidly in the flues, until in the dust precipitator which is contemplated to be used to recover the ashes for treatment in this process the temperature of the gases may be as low as 500 deg. C. This high initial temperature and comparatively rapid cooling produce certain chemical and physical transformations and produce certain minerals or crystal forms in the ash particles. The effect of these chemical and physical transformations is to make the basic content of the ashes more readily soluble in the mineral acids mentioned above, thereby permitting their removal.

The usual range of chemical composition, and the actual chemical composition in one particular instance, are given in Table 1.

	Usual Range, Per Cent	Actual Composition of a Typical Sample
Silica (SiO_2)	40—50	46.9
Alumina (Al_2O_3)	25—35	29.3
Iron oxides (Fe_3O_4—Fe_2O_3)	9—15	11.7
Magnesium oxide (MgO)	0.4—1.3	0.9
Lime (CaO)	2— 3	2.6
Titanium (TiO_2)	1— 2	1.3
Carbon	5— 8	6.5
Unclassified	----------	0.8
		100.0

As previously mentioned, the process contemplates the use of some form of dust collector to recover the ashes at the base of the stack, such as a Cottrell electrostatic dust precipitator. In the use of this precipitator for the separation of the ash particles from the hot gas stream, the flue gases are drawn through the precipitator by means of a suction fan. Essentially the separating device consists of positive and negative poles where, by means of a voltage of 100,000 to 150,000, an electrical discharge passes through the moving gas stream and a charge or potential is thereby placed on the ash particles, which causes them to be attracted to one pole and to be deposited upon it.

In following through with the processes, a slurry of the recovered ash particles is then formed by mixing with water, and this slurry is then pumped into treating tanks for recovery of the alumina and iron oxides.

Removal of Iron Oxide

One method for removing the magnetic iron oxide (Fe_3O_4) is to pass this slurry through a magnetic separator. After removal of the magnetic iron oxide the residue is preferably treated with a suitable quantity of one or more of the mineral acids previously mentioned. It has been found quite satisfactory to use hydrochloric acid in an aqueous solution at a strength of anywhere from 5 to 20 per cent, depending upon the physical properties and the chemical composition of the ashes.

Recovery of Alumina

The percentage of alumina to be extracted depends in large measure on the quantity of alumina desired to be retained in the ashes for use as cement raw mixture. Obviously a needless expense would be involved if the quantity of alumina recovered were so great that additional alumina would have to be provided through the later addition of clay or other ingredients. The quantity of alumina extracted can be controlled by increasing or decreasing the strength of the acid and varying the time and temperature of the treatment. The alumina recovered is, of course, a valuable by-product. The recovered magnetic iron oxide is a product that is suitable as a paint pigment or as ore of high iron content.

The minor oxides, which are present only in small quantities, need not necessarily be removed, for after extracting the magnetic iron oxide and the desired proportion of the alumina, the remaining product is essentially a siliceous hydrate suitable as a raw material in cement manufacture.

The process that is here briefly described is covered by U. S. Patent No. 1,874,186, granted on August 30, 1932, to William M. Guertler, of Berlin, Germany, who in turn has assigned the American rights to the Electric Smelting & Aluminum Co., of Cleveland, Ohio. Application for the patent was filed on March 21, 1930, serial No. 437,947.

◆ EDITORIAL ◆

Returning Coal Ash to the Mill Stream

MANY investigators have attempted to find uses for the coal ash produced wherever pulverized coal is used as fuel. Varying degrees of success have met these efforts.

The cement industry produces this coal ash, both in the kiln and in the boiler house. Whether to recover the ash or to let it be carried out through the stacks is usually decided by the attitude toward the dust nuisance. In cases where dust is recovered it is often done as a gesture of good will toward the community, rather than for the purpose of recovering a by-product.

The fact remains that cement plant operators have in times past made various attempts to recover stack dust for commercial purposes—and some are doing so at the present time—but these activities were connected chiefly with the recovery of potash.

Now it appears, from an article printed in this issue, that the coal ash produced in the manufacture of portland cement may find its most logical use as a raw material for cement itself, after several useful by-products are removed by means of chemical treatment.

The chemical analysis of coal ashes varies, quite naturally, with the particular kind of coal employed in burning cement; but in general it can be said that coal ash is predominantly composed of silica and alumina. There is also a considerable range of variation in the chemical analysis of the ashes of the same coal. In spite of the difficulties that may arise as a result of these variations, they are probably no greater than the difficulties due to variations in the analysis of other raw materials.

Certainly the possibilities are worth investigation, especially in plants where the kiln stack dust is now being recovered primarily as a means of removing the dust nuisance.

Standing by Their Guns

A COMMENDABLE spirit and much patience has been shown by the cement companies shipping into several midwestern states, in the face of political attacks and newspaper criticisms because of identical bids on cement for state highway departments.

In Illinois the attack has been the most prolonged, as well as the most clamorous, of all the states where trouble has been encountered. The latest phase has taken the form of an alleged offer by the state to lease one of the existing cement plants.

Reams have been published in explanation of the bidding methods employed, and in justification of the submission of identical bids.

Possibly those explanations have been too complicated for politicians to understand, even if they had a desire to understand them. They might comprehend the situation better if they were reminded that they will pay the same price for a ton of coal, regardless of which company delivers it.

Any other selling policy leads directly to price cutting—and the cement industry has had its fill of that.

Looking Over a Few Cement Plants

A. W. ROBERTSON, chairman of the Committee on Industrial Rehabilitation, has taken a look at the cement industry. He has spoken out loud in telling of some of his observations.

In one instance the manager of a large cement plant, now idle, admitted that when the time comes to start again it will be necessary to spend upward of a million dollars before a wheel can be turned—in a word, the mechanical installations must be largely replaced with modern equipment.

Another plant, of moderate size, during normal production volume keeps six slurry pumps in operation. For several years only two of the pumps have been in use. Whenever repair parts were needed they were taken from the four idle pumps, not one of which is now in a condition to operate. A sudden demand requiring the use of even one additional pump would find the operating department crippled.

These two examples are painfully typical of the condition of a number of cement plants. For two or three years the executive officers have followed the policy of not spending a cent until absolute necessity forced them to it. Their plants are obsolete. A pick-up in demand will find them unprepared to take advantage of it. If they attempt to meet the demand through the use of obsolete equipment they will operate at a loss, on the basis of present price levels for cement.

In cases where funds have not been available, and neither money nor credit could be obtained, managing executives have had their hands tied. But the fact is that some of our obsolete cement plants are in their present condition because of unwillingness to spend available funds to keep them modernized.

It may be accepted as a foregone conclusion that some executives and boards of directors of such companies will wait too long.

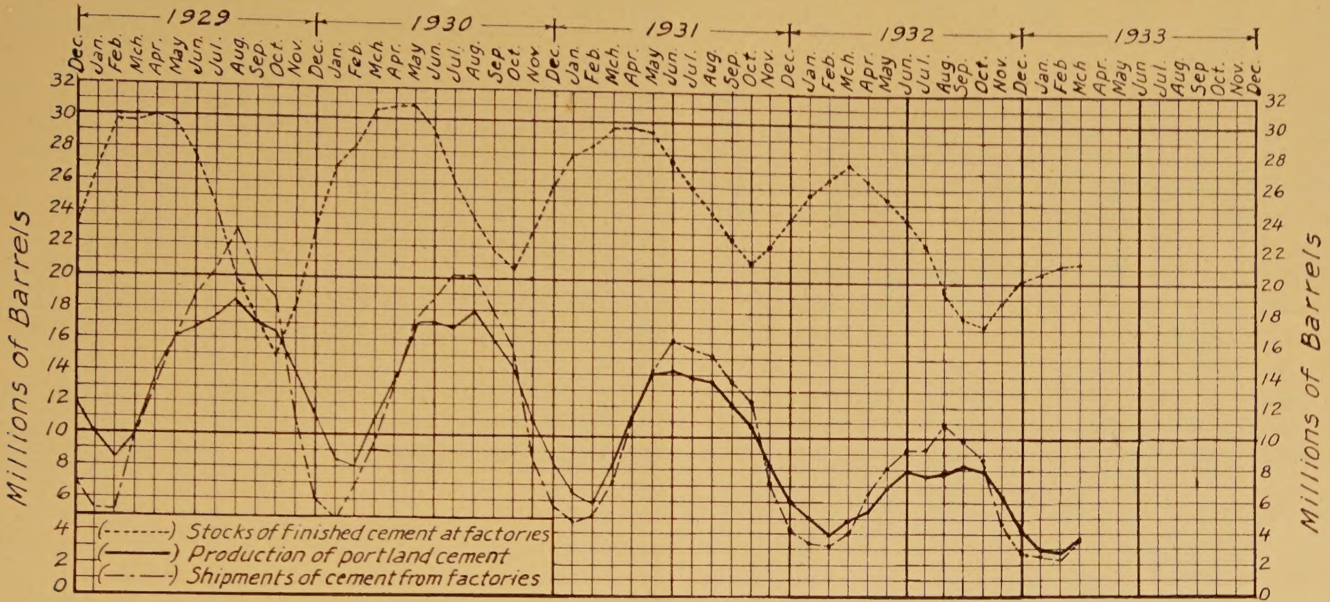
Cement Statistics for March

Relation of Production to Capacity (Per Cent)

	The Month	Twelve Months
March, 1933	16.1	26.7
March, 1932	21.3	43.8
February, 1933	13.4	27.1
January, 1933	12.9	27.6
December, 1932	18.5	28.3

Production, Shipments and Stocks of Finished Portland Cement (Barrels)

	1932	1933
Production, March	4,847,000	3,684,000
Shipments, March	3,973,000	3,510,000
Stocks at end of month	27,545,000	21,298,000
Production for year to date	13,844,000	9,414,000
Shipments for year to date	10,484,000	8,287,000



Regional Safety Conferences Scheduled by Council

Regional conferences scheduled by the National Safety Council for the coming weeks include the following:

May 4—Ninth annual eastern safety conference, Robert Treat Hotel, Newark, N. J.

May 9—Sixth annual Rock River Valley safety conference, Fort Atkinson, Wis.

May 24-25—All-California accident prevention conference, San Francisco, Calif.

May 25—Northwestern Pennsylvania seventh annual regional safety conference, Erie, Pa.

June 22—Third Wisconsin River Valley safety conference, Wisconsin Rapids, Wis.

Chemical Exposition Display Work Begun

Three floors of Grand Central Palace building, New York City, have been reserved for the Fourteenth Exposition of Chemical Industries, to be held the week of December 4.

Practical and interesting exhibits are planned. Sections already established are those devoted to natural resources and raw materials, chemicals and chemical products, mechanical handling of materials in plants, laboratory equipment and supplies, plant equipment, and instruments of precision.

Louisville Plant Reopens

The Speed, Ind., plant of the Louisville Cement Co. reopened on April 15, employing about 300 persons.

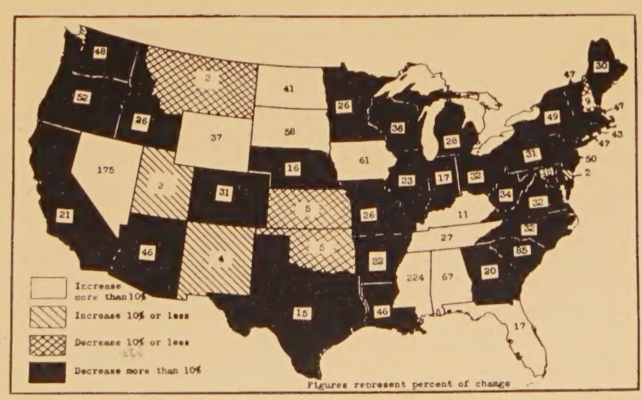
Cement Industry of Tennessee

A detailed article by Walter F. Pond, state geologist for Tennessee, appears in the Knoxville, Tenn., *Journal* of February 26.

Progress of the industry is traced from the time of the first manufacture of a natural hydraulic cement in 1849, in Hardin County.

The present portland cement industry of the state is represented by six plants, of which one is located at Nashville, three in the vicinity of Chattanooga, one at Knoxville and one at Kingsport, near Johnson City.

The March Cement Map



This map, issued by the U. S. Bureau of Mines, shows comparisons between portland cement shipments in March, 1933, and shipments in March, 1932.

Bronze-Welding of Damaged Kiln Blocks Avoids Replacement Expense

Repairs Completed at Small Cost—Welding Procedure Described—Discarded Trunnion Roller Reclaimed for Further Service

SERIOUS damage to eleven of the cast iron trunnion bearing blocks supporting a 290-ft. rotary kiln gave promise of a large bill for replacements, when a certain cement manufacturing plant was checked up for the necessary repair and maintenance work in the early part of 1932.

The bearing blocks in question are cored for the circulation of water, in order to keep them cool during operation. Inadvertently the blocks had not been drained, upon the approach of cold weather, and the water had been permitted to freeze inside them. The expansion of the ice had fractured the blocks to the extent that it was proposed to scrap them.

Repair Versus Replacement

Replacement of the eleven blocks would have cost about $5,500, an item of considerable importance under present conditions. Rather than order new blocks immediately, possible plans for repairing them were investigated. Oxy-acetylene welding was the method finally decided upon as a means of repairing the blocks at relatively low cost.

These blocks weighed approximately 1,500 lb. each, were about 40 in. square, and the sections that would have to be welded together varied in thickness from 2½ in. to 4 in. The oxy-acetylene service operator figured that, by the use of bronze-welding, about 8 hr. of welding would be required to repair each block. The operator explained the correct procedure to the plant's welders and immediately preparations were started.

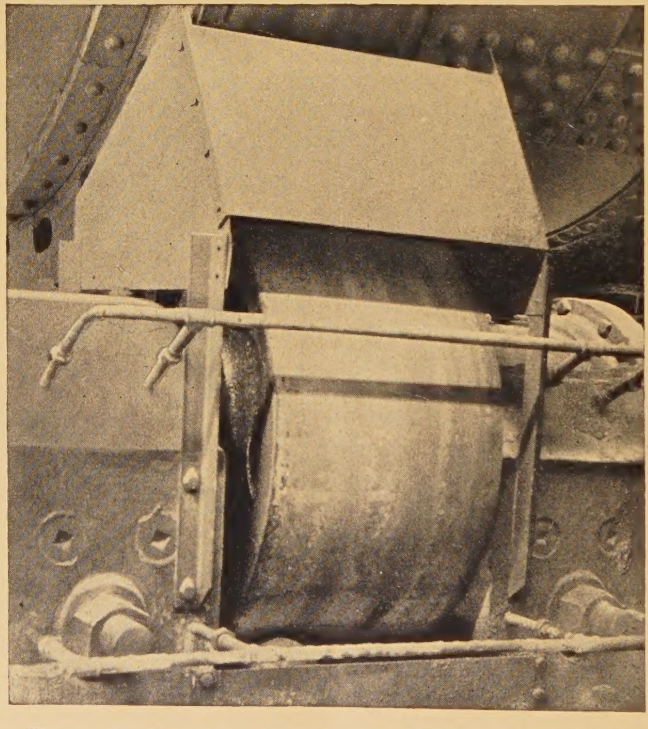


Figure 1. General view of one of trunnion bearing blocks which support the rotary kiln

Repair Methods

Arrangements were made to vee out the cracks in the first group of blocks, six in all, which were first removed from under the kiln. Because these blocks supported the kiln, not all of the damaged ones could be removed at one time without materially weakening the temporary supports that were placed underneath the kiln. At the same time a small pipe line to supply natural gas for preheating the blocks was run over to the location of the kiln where a temporary preheating furnace was to be built. The idea in all of this preparation work was to prepare at the same time as many castings as possible for welding, so that there would be no interruption in the bronze-welding operation once it was started. Preheating the blocks not only shortened the welding time but conserved welding gases.

Two days after the decision was made to repair by bronze-welding, the first six bearings were all chipped out, vee'd and ready for the repair work, two of them being already heated to the proper temperature for bronze-welding in the preheating furnace. Once the work was started, the operations were carried out in rotation as each block was preheated and bronze-welded. About 8 hr. of welding was sufficient to complete each casting, with an average consumption of 60 lb. of the new bronze-welding rod.

Completed at Small Cost

The total cost for the welding of the eleven blocks was $385 for welding material and labor, or an average cost of $35 each. In consequence, the cement company was able to correct the damage through an expenditure of $385 for repairs, instead of having to meet a bill of $5,500 for replacements.

After the completion of the welding of the trunnion bearing blocks, the superintendent examined a large trunnion roller which had been scrapped some months previously after it had broken through the hub and spokes. At the time the roller was scrapped the management considered that repairs were out of the question, because of the weight of the casting—about 13,000 lb.

Now, as a result of the experience and confidence gained from the repair of

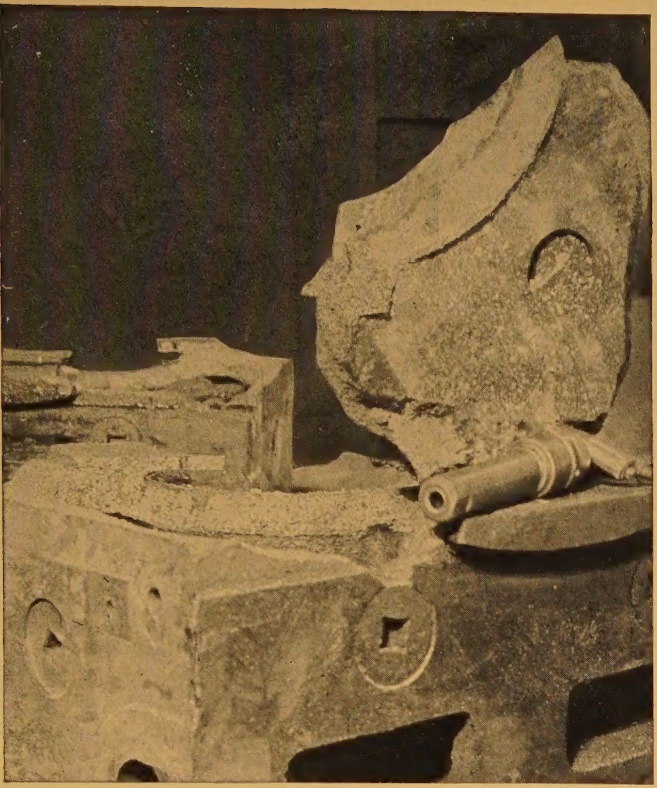


Figure 2. One of fractured blocks prior to its preparation for bronze-welding

the trunnion bearing blocks, the welders were put to work on the discarded trunnion roller, which, when in service, is mounted on a 14-in. shaft and is used as a roller to support the rotary kiln.

In spite of the great weight of the casting, the welding operation was successful and the trunnion roller was restored and made available for further service.

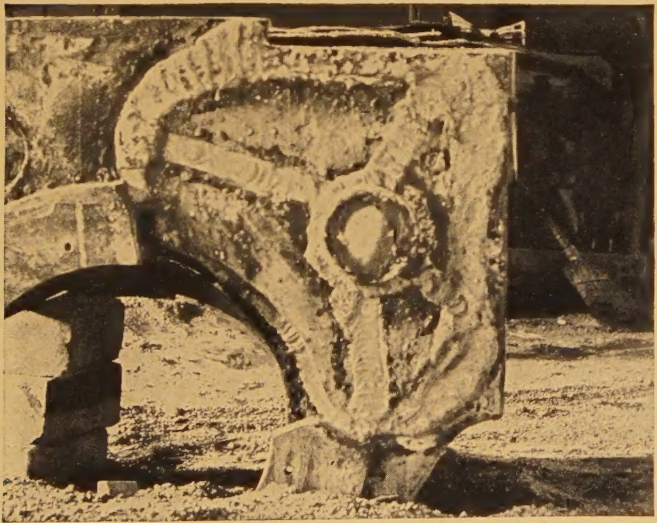
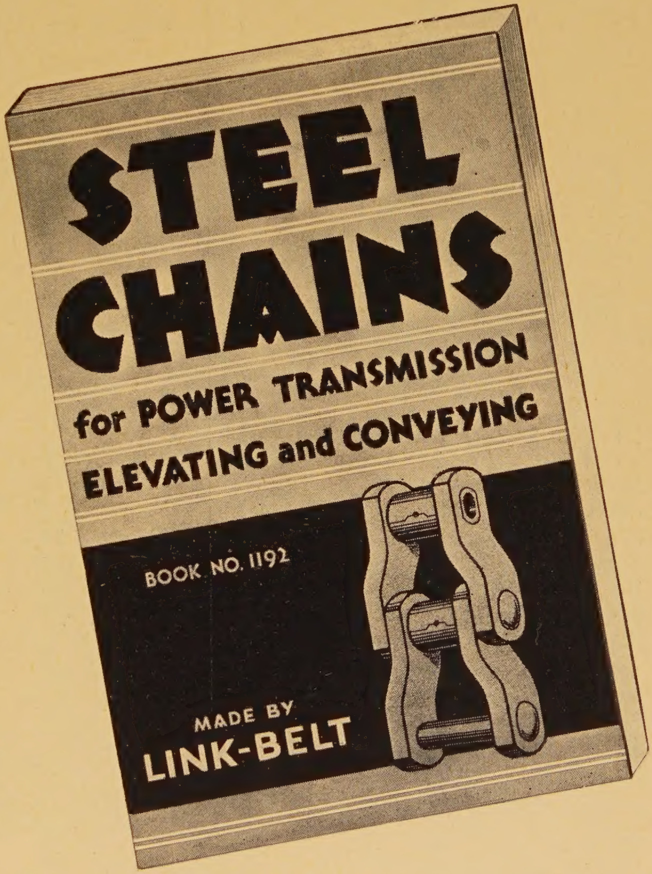


Figure 3. One of fractured blocks partially bronze-welded

While work of this size and character is not an everyday occurrence in a cement manufacturing plant, it is of considerable value to know that such work can be successfully performed by the oxy-acetylene bronze-welding process.

Book on Steel Chains!



IT LISTS, describes and illustrates the comprehensive line of Link-Belt Steel Chains which have been developed in a wide range of strengths, pitches and types to meet the present day requirements for steel sprocket-chains.

Those who are familiar with Link-Belt Steel Chains will welcome this book, as it not only brings all the information on older chains up-to-date, but also offers many new and useful sizes. Address nearest office.

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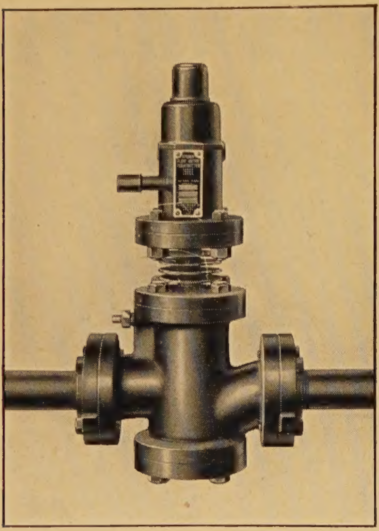
MILL EQUIPMENT

Brown Area-Type Meter for Fluid Flow

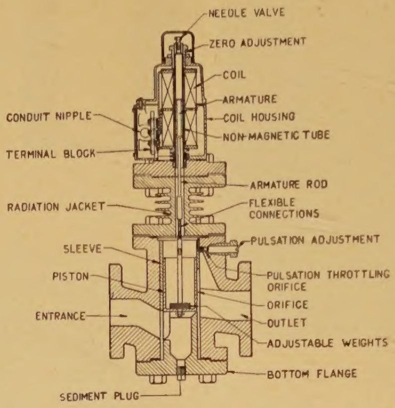
The Brown Instrument Co., Philadelphia, Pa., has developed and is now manufacturing a new type of flow meter. This meter, the Brown area-type unit, is designed to measure fluids, such as the flow of fuel to oil-fired kilns and the water supply to boilers.

The Brown area-type meter is calibrated to give equal increments in deflection for equal increments in flow, hence the scales and charts are evenly graduated. Since this is accomplished without the use of cams or specially shaped pressure chambers, the forces which shift the piston position are actually as great at small flows as at large flows. This makes this meter extremely accurate at low flows as well as at large flows, it is stated.



Equipment consists of the meter body, recording or indicating meter, and connecting wiring.

The construction of the meter body is of the piston and sleeve type. The flowing fluid enters the meter body at the entrance, passes under the piston, through the orifice, and is discharged.



As the fluid enters the meter body it strikes the bottom of the piston. Since the piston is free to slide vertically upward, it will be lifted, exposing a section of the rectangular orifice in the sleeve.

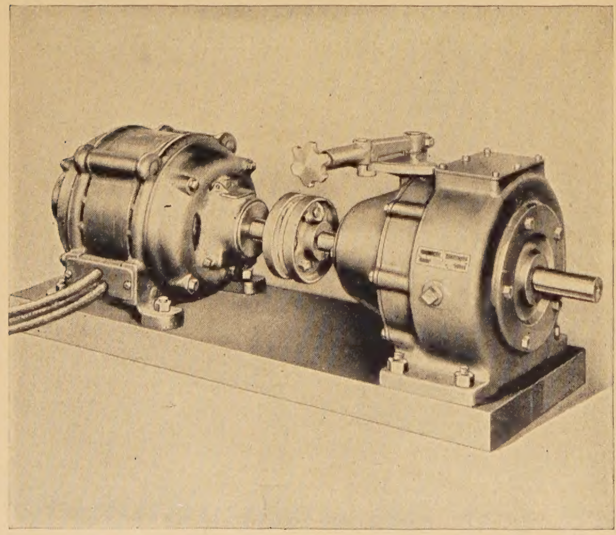
Features of Johnson Variable Speed Reducer

The Smith Power Transmission Co., Cleveland, Ohio, after four years of development announces the Johnson variable reducer.

Designed to meet a very definite need, this is an infinite variable speed reducer self-contained, running in a bath of oil. It will give infinite speed, using a control from zero to any desired speed, using a control that is visible and quickly manipulated, and a stopping position that is said to be superior to a clutch.

The Johnson variable reducer, shown to the left, is claimed to be noiseless in operation, with a very high efficiency. Its capacity ranges from 1 hp. up.

An outline of the features is contained in a descriptive folder.



New Steam Generating Unit for Small Plants

The Combustion Engineering Corp., New York City, announces the C-E steam generator unit, a standard design built in a range of sizes for capacities of 8,000 to 40,000 lb. of steam per hour. The principal features of this unit are its economy of first cost and operation, its compactness, and its suitability for firing by pulverized fuel, oil or gas.

Field Activities

De-Duster Bulletin

Bulletin 1413 covers the *Blaw-Knox De-Duster*, for removing fines from raw material. This is a late publication of the *Blaw-Knox Co.*, Pittsburgh, Pa.

The De-Duster, described as a highly developed machine, handles all sizes from 1½ in. down and removes all dust from 10 mesh down to the most impalpable fines.

Chains and Conveyors

Conveyor belts, chains of various types, and like equipment are described in *Bulletin* 231, published by the *Chain Belt Co.*, Milwaukee, Wis.

This is a multiple-page folder of a handy size.

Industrial Literature

Woodward Joins B. & W.

The Babcock & Wilcox Co., announces the addition of *Mark R. Woodward* to its cement equipment division. For the last 15 years Mr. Woodward has been assistant chief engineer of the Lehigh Portland Cement Co., with headquarters in Allentown, Pa., and an active member of the A.I.E.E.

Mr. Woodward will be located in the Chicago office of the Babcock & Wilcox Co., at 20 North Wacker Drive.

Westinghouse Appointments

R. E. Hellmund has been appointed chief engineer of the *Westinghouse Electric and Mfg Co.*, E. Pittsburgh, Pa.

H. W. Cope, formerly assistant director of engineering, has been made assistant to the vice-president, responsible for the coordination of certain headquarters engineering departments and district office engineers.